REPORT OF THE AIR FORCE SCIENTIFIC ADVISORY BOARD AD HOC COMMITTEE ON THE JOINT MODELING AND SIMULATION SYSTEM (JMASS)

1.0 INTRODUCTION

An Ad Hoc Committee of the Air Force Scientific Advisory Board (SAB) convened on 4 November 1993 to begin a study of the Joint Modeling and Simulation System (JMASS), as requested by AF/TE and AF/XOM. The task statement, included in its entirety in Appendix A, can be summarized as follows:

- Review the JMASS for consistency and congruence between technical focus and resource availability
- Compare requirements driving the JMASS program with the actual direction of the program; and
- Investigate the extensibility of JMASS to meet Air Force needs in modeling, simulation, and analysis (MS&A).

The Committee comprised three SAB members, Dr. Alexander H. Levis, chair, Mrs. Natalie Crawford, and Dr. Charles Morefield, and two ad hoc advisors, Dr. Duncan C. Miller and Dr. Cindy Williams. All are experienced in the various aspects of JMASS, both in terms of the underlying technology and in the potential applications. The active senior civilian participant was Dr. Marion L. Williams. A list of the members of this Committee and their affiliations is presented in Appendix B.

The Committee received a number of briefings related to JMASS on 11 and 12 January 1994 (Appendix C) and prepared a briefing with its findings and recommendations. The Committee presented this briefing to the sponsoring organizations on 2 February 1994 (Appendix D). Participants in this and other briefings raised several issues and concerns, which the Committee later took into account. Thus, the report reflects the final result of the Committee's work. It differs in several respects from the Committee's initial work (as summarized in the briefing charts in that it expands on and clarifies several recommendations).

This report describes JMASS and presents the findings of the Committee, which address JMASS issues at the System Program Office (SPO) and Air Force levels. Finally, recommendations are given based on the study findings.

2.0 WHAT IS JMASS?

This study focused on Release 2 of JMASS. While members of the Committee reviewed earlier documents on JMASS, it was decided that Release 2 was sufficiently different on the one hand and sufficiently developed on the other that discussion of earlier releases would not be constructive. It should be emphasized, however, that Release 2 was being distributed at the time of the study, so external users have not had time to test and evaluate it. The Committee evaluated JMASS on the basis of presentations, associated formal documentation, and answers to many technical questions.

JMASS is a simulation support system that contains a simulation engine, an event processor or scheduler, and an interconnection backplane that enables intermodule communications. This means that JMASS is a software environment in which different modules can be inserted and executed, provided they meet some implementation standards.

Given this basic characterization, JMASSneeds to provide additional services to potential users. Thus, it is also a developer's toolkit, providing an environment and a set of tools for the development of models that can then populate the JMASS model library. The toolkit can also be used to support the development of simulations, that is, to create the modules needed to implement a particular simulation.

At the next level, JMASS is a simulation configuration toolkit. It provides an environment and a set of tools for constructing scenarios and simulations from existing components to address specific issues, assuming that component models and simulation modules already exist in JMASS).

Finally, JMASS is an analyst's toolkit. This kit contains algorithms and graphics modules for analyzing and plotting the results of simulation.

In brief, JMASS provides the infrastructure for modeling, simulation, and analysis. It is not a model in itself, but it uses models (new ones or from a library of models). It is not a simulation, but an environment for developing, configuring, and executing simulations and for analyzing the results. To use an analogy from the 1993 SAB Summer Study on Information Architectures, JMASS is like a new development where the developer has built the roads, laid the water pipes, laid the electric and communications networks, zoned the area, and even built a model home. Now it is for future residential and business customers of this community to build their individual homes, offices, and stores, as well as hospitals, police stations, and community centers. The developer can continue developing and enhancing the infrastructure and even build some of the buildings, but most of the building will be done by the customers, using their own resources. It is also possible to bring in prefabricated units or even

move old buildings to the new location. The latter is feasible, but has some inherited constraints.

The basic architecture of JMASS is shown in Figure 1. The various functions that can be performed using JMASS can be depicted as alternative configurations based on this architecture.

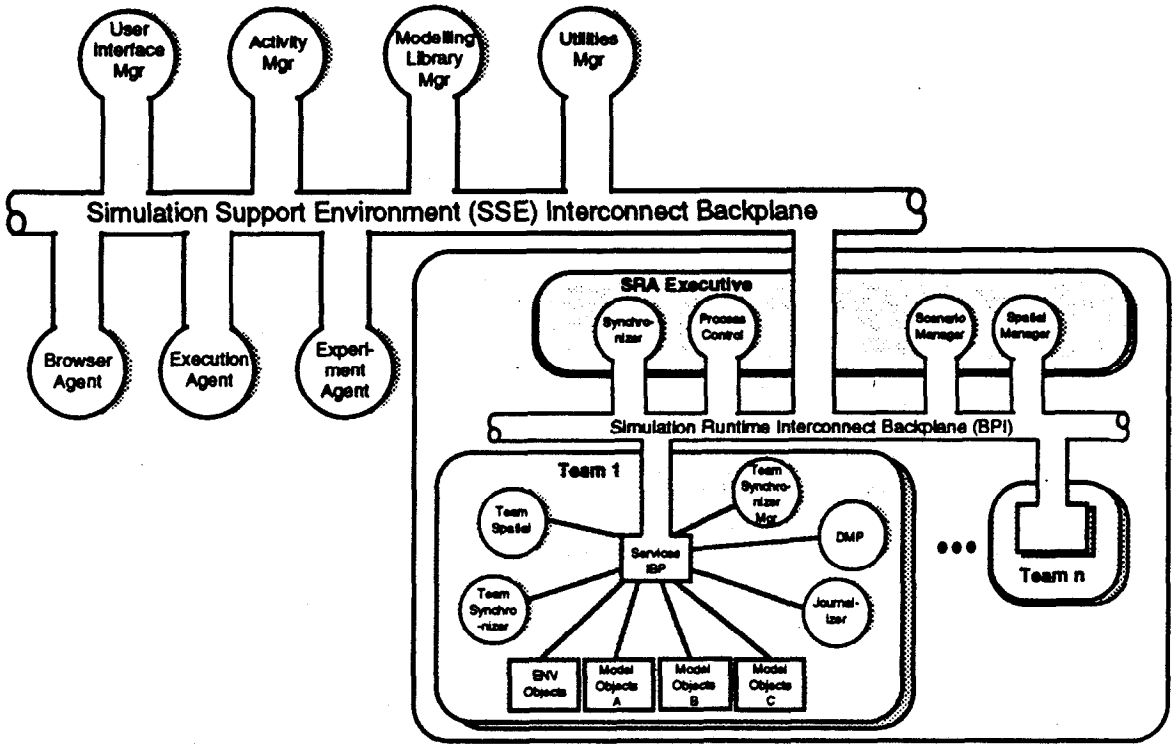

Figure 1. Basic Architecture of JMASS

3.0 FINDINGS

The next two sections present the findings of the Committee. The findings are organized into two groups: those that address issues at the JMASS SPO level and those that address JMASS issues at the Air Force level.

3.1 JMASS Findings at the SPO Level

The basic finding is that *the Air Force needs a simulation environment of this type for modeling, simulation, and analysis.* While various architectures for that environment, each one offering some possible advantages, can be imagined, any such proposed architecture must include the basic features now incorporated in JMASS. Therefore, the question is not whether other simulation environments could be constructed, but

rather whether JMASS as envisioned will ultimately have the requisite properties and capabilities to be that environment.

JMASS, as exemplified by Release 2, is a viable implementation of an architecture for modeling, simulation, and analysis. While it is not yet a complete system, that is, not all features have been implemented, it has enough features and capabilities to begin being used. The Committee did not believe that the issue is whether to discontinue JMASS and embark on another similar development, possibly with some different and improved features, but whether JMASS is good enough to become a common environment for Air Force (and possibly Joint) MS&A. If this is the case, then the question changes to whether the current direction of JMASS development is the appropriate one, or whether a different direction must be taken.

The Committee realized that the current fiscal environment often forces developers to divert energy and resources to secondary objectives because funding can be secured to support them. The underlying assumption is that any additional funding contributes to the development of the overall system. This may be so, but such additional funding tends to diffuse the focus of the effort, expand the scope, and result in confusion. It is the finding of this Committee that *the advertised scope of JMASS is too broad in view of possible funding sources and of what can be accomplished realistically in the near future.* Furthermore, such breadth of scope raises unfulfillable expectations and reduces the credibility of the overall effort. The issue of the near future is an important one. Software technology is developing rapidly; in a few years it is almost inevitable that a new development will be proposed that will be better. But it will take years and substantial resources to develop. The answer is to limit the JMASS scope to provide a complete working version soon (Release 3) and then to require that future developments have backward compatibility with the JMASS models.

While it has been presented as capable of handling modeling and simulation at any level, *JMASS has been used for building detailed emulation models.* The Committee was informed of current efforts to build higher level models.

The simulation engine of JMASS is an event-driven one. It can also support time-driven simulations. An event-driven simulation is one in which events can occur at arbitrary times (asynchronously and concurrently) and cause other events to occur. The updates of information occur as data become available, not at predetermined fixed intervals. Note that an event-driven simulator can support a time-driven one by the introduction of a clock and by the consideration of clock times as events that control the evolution of the simulation. This is a desirable feature of the simulation engine.

Given the current state of development of JMASS , its greatest utility in the near future is in the support of analyses at the tactical/engagement level. While it is true that JMASS could support simulations at different levels of the modeling hierarchy (from engineering to campaign), it will require time, resources, and new methods of

aggregation to support multiple levels. The Committee believes that at this time, the preferred level is the tactical/engagement one.

JMASS is indeed an environment in which simulations can be constructed and executed. These simulations can be at different levels; however, models and modules need to be developed to support each level. For example, JMASS could be used to develop and support MS&A at the campaign level, but not by running models constructed for the engagement level using an expanded data set to account for many simultaneous engagements. *The ability to support simulations at different levels is not equivalent to supporting simulations across levels. The issues here are complex and are outside the scope of JMASS.* They have less to do with software interoperability than with interoperability of models at the application level. While constructing a simulation across levels is not impossible, each case must be thought out carefully so that data crossing levels have common meaning across the levels. The problem is in modeling, not software.

The current JMASS architecture is capable of connecting to the Distributed Integrated Simulation (DIS) system. Data from DIS can be pulled into the simulation, and data can be exported to DIS. *But the connection is a nominal one;* neither system is optimized for it.

The JMASS architecture is capable of integrating both hardware-in-the-loop and humans-in-the-loop. However, *actual implementation of these capabilities would require substantial effort* to ensure that the hardware events (or the human events) are synchronized correctly with the simulation events.

Both capabilities are necessary if one of the objectives of JMASS is to support training. The point here is that with sufficient infusion of time and resources, JMASS capabilities can be enhanced in different directions. *Priorities need to be established by the users.*

The overall finding is that *the architecture of JMASS (Release 2),* as described in the briefings and the supporting documents, *is sound* and consistent with the state of the art in the period 1990-93. *However, the performance characteristics of the actual implementation have not yet been tested.* In January 1994, Release 2 was distributed to a number of beta sites, to both DOD organizations and industry. These sites should provide useful performance data.

The decision not to include commercial off the shelf (COTS) may have been correct at the time it was made, but it was based on the then-prevailing license costs and procurement issues. As this has been a rapidly evolving situation, such decisions need to be updated periodically, based on functionality and long-term support costs.

3.2 JMASS Findings at the Air Force Level

Since JMASS is not a model but a software environment for modeling, simulation, and analysis, the Committee expressed concern that *there is no current plan to undertake a major study or analysis that uses JMASS.*

JMASS by itself does not produce results. It must be populated with models and simulation modules if it is to be useful to the test and evaluation (T&E) and MS&A communities. *The Committee did not identify any firm commitments by any organization to build models for inclusion in the JMASS model library.* Both NAIC and MSIC have used it to develop models and have undertaken the development of dynamic models, but that is not sufficient. Legacy models (existing models and model components) could be incorporated, if required, but this requires some effort, either for encapsulating the models or reengineering them or both.

The Committee was unable to identify an operational requirements document that could guide the SPO. While the SPO has plans for the further development of JMASS, these plans are driven by the internal needs of JMASS and by whatever assessment the SPO can make of users' needs.

JMASS Release 2 has been distributed to at least 13 beta sites (the Committee recognizes that the distribution is continuing and that the number is substantially higher now). While this will encourage and motivate organizations to develop models and configure simulations using JMASS and, accordingly, generate requirements for JMASS, *the Committee does not consider this approach to be a sufficient substitute for (1) an operational requirements document and (2) a clear plan for populating JMASS with models.*

4.0 RECOMMENDATIONS

The Committee's basic recommendation is that JMASS be continued only if the Air Force is prepared to change the direction of the JMASS program from development of a largely unpopulated infrastructure to use of that infrastructure in one or more major applications (studies or analyses). Further development of JMASS should be driven by and be subordinate to application needs. Release 2 of JMASS provides an initial capability. The program must now focus on supporting Air Force objectives.

The Committee is in no position to recommend specific studies. These recommendations must come from the "user" community, which in this case includes the T&E and MS&A communities, as well as selected SPOs. Once specific applications that will employ JMASS are selected, *documented requirements to support these applications must be transmitted to the JMASS SPO.*

Any application will involve a number of "stakeholders," such as the end-users, organizations such as AFOTEC or DMSO, analysts, model developers, and JMASS

developers. *The stakeholders for any specific application must be brought together and organize to carry out the work.* This is important if focus is to be maintained on providing results that address Air Force issues.

Once an application is selected, then *sufficient funds must be allocated to all stakeholders to see it through.* The Committee could not answer in absolute numbers the question of what the appropriate financial commitment should be. The answer can be approached through two analyses: (1) how much it would cost to carry out the selected application, and (2) whether the application is of sufficient value (or worth) to the Air Force to warrant that expenditure. Since the focus should be on the applications, and different applications may require different levels of effort, it is not possible to say how much is enough. (Even $1 is wasted if it is spent on gratuitous infrastructure development. On the other hand, spending $10 million to obtain credible answers that may save several hundred million dollars in a procurement is a bargain.)

JMASS performance should be tested in a variety of rapid demonstrations. The JMASS SPO has already done several in the process of demonstrating the capabilities of JMASS. Information from the beta sites should be collected and shared among the users of JMASS; it is neither possible nor desirable for the SPO to carry out these tests.

The Committee recommends that the initial set of applications focus on the tactical or engagement level. This level appears to require the least amount of further infrastructure development and the highest payoff. Other levels, such as campaign, are possible, but first the driving issues should be identified, and then an analysis should be done to determine the availability of legacy models, the extent of reengineering necessary, and the new models that will need to be built to address the selected issues.

The software engineering field is undergoing rapid change. Within the Air Force, in the other Services, in the broader DOD community, and in the commercial sector, developments are taking place that can benefit the evolution of JMASS. *The Committee recommends that the JMASS SPO continually reevaluate the use of COTS software and middleware, particularly for toolkits and data base management systems, and that it establish closer connection to other Air Force software efforts.* Interaction with the PRISM office at ESC can provide useful information on COTS.

The Committee is concerned that JMASS be focused on and that further work be driven by Air Force applications. To maintain this focus, which is very distinct from that of the developer, *the Committee recommends that a small advisory group consisting of three to five individuals be formed* to

- Advise the JMASS SPO on software engineering technology, modeling and simulation technology, and use of COTS and government off-the-shelf (GOTS) software

- Ascertain that further JMASS efforts are driven by Air Force applications
- Provide an interface with potential users of the simulation during requirements definition.

5.0 CONCLUDING REMARKS

During the several briefings of the study, the audience posed a number of questions. Those questions have prompted the following concluding remarks.

The question of multilevel simulations or simulations across levels appeared to be a major concern. To clarify some of these issues, an illustrative analogy was presented at the briefings in which a common spreadsheet and its uses were compared with JMASS and its uses. This analogy is presented in Appendix E.

The question of standards was also raised. Please note that *there is no recommendation in this report to adopt JMASS as the Air Force **standard** for modeling and simulation.* This is deliberate on our part. With the software industry in ferment on tools and languages, JMASS should not be viewed by the Air Force as a long-term standard that all simulations should be forced to accommodate. Instead of looking at whether JMASS can serve as the means for defining standards, the Committee focused on whether JMASS is sufficiently flexible to be able to accommodate new software developments and the integration of COTS. As a software development system, JMASS induces some implementation standards so that different models and modules can be inserted and executed. The Committee was more concerned that models built to populate JMASS or legacy models reengineered to work as part of a JMASS-based simulation continue to be usable in the future, even after the current JMASS code has been totally replaced. This is why such phrasing as "future developments have backward compatibility with the JMASS models" has been used.

To continue with our spreadsheet analogy (or any major word processing software), the current versions of popular spreadsheets have very little in common with the original versions in terms of code. As a matter of fact, they have been totally recoded several times in the last 6 or 7 years. Though capabilities have been expanded and features added to the spreadsheets, the developers have made sure that they can still read models developed with older versions and that users of older versions can perform basic operations with the new versions without much difficulty. Interoperability from the user's point of view is the key issue.

The Committee's recommendation to develop a large model in JMASS and carry out a major study was driven by the near-term simulation needs of the Air Force and by the need to actively develop models for the system if it is to ever be useful and trusted as a tool. We recognize that there is a risk involved. This Committee's effort was directed at reducing the risk; we endeavored to explore various aspects of JMASS

and clarify some of the underlying issues regarding its use by the T&E and the MS&A communities. The recommendations we presented focus on reducing the risk further—by constraining future development and testing of the JMASS toolkits to the context of an engagement-level application and in close cooperation with all the stakeholders in that application.

6.0 ACKNOWLEDGEMENTS

The Ad Hoc Committee acknowledges with appreciation the support it received from Lt Col David B. Russell, Capt William M. Cashman, and Capt Richard Painter of the Joint Modeling and Simulation System Program Office; Mr. G. Francis Kline, MSIC; Mr. Richard E. Sharp, NAIC/TAEM; Dr. Dale B. Henderson, Los Alamos National Laboratory; Capt Paul A. Valdez, ESC/ENSF; Mr. David A. Hall, NAWCWPNS; Col George DeGovanni, HQ USAF/AFSAA; David E. Anderson, HQ USAF/AFSAA; and Maj Bryan K. Ishihara, TEP. Dr. Joseph D. Morgan, III, from ANSER provided the staff support for the study, and Maj Gaetano De Gioia, HQ USAF/SB, as the Executive Officer for this study, made it possible.

APPENDIX A

TASK STATEMENT

USAF SCIENTIFIC ADVISORY BOARD (SAB)
TASK ON
JOINT MODELING AND SIMULATION SYSTEM EFFORTS

Subject: The Joint Modeling and Simulation System (JMASS).

Problem: Properly focused, directed and implemented, modeling, simulation, and analysis (MSA) techniques provide tools to effectively evaluate many aspects of the restructuring, downsizing, and concept development needed by the Air Force now and in the future. In an era of shrinking resources, the Air Force needs to ensure proper focus and broad-based utilization of one of its premier evaluation and analysis tools, the The Joint Modeling and Simulation System (JMASS) JMASS. Using the JMASS architecture standards, the Air Force can best focus its critical MSA resources through development of simulation models and modules that interact under a common JMASS operating environment, thus eliminating duplicative and parallel modeling efforts.

Recent communication among AF/TE, SAF/AQ, AF/XOM, and the USAF SAB raises a potential concern regarding the focus and direction for JMASS. The JMASS program and associated efforts, such as the Survivability Modeling and Range Testing (SMART) program, are important development efforts that should have clear direction and focus in order to make best advantage of the MSA advances needed in today's environment.

Task Description: The SAB Chair will form a Ad Hoc Committee to review the JMASS program for consistency and congruency among program direction, validated requirements, technical focus, and resource availability. The Committee should focus on the requirements driving the program versus the actual direction and technical development effort. The Committee should also investigate the extensibility of the JMASS architecture standards to address not only its current development direction but also the flexibility and robustness to evolve into a modeling simulation, and analyses operating environment that would allow interaction of object-oriented testing, training and analyses constructive, live, and virtual simulations to support the broad MSA community.

The Committee should make a brief, intense review of the program and prepare a succinct presentation for review by the heads of the affected Air Force organizations, including SAF/AQ, AF/XO, AF/TE, HQ AFMC, HQ ACC. The Committee should be small, consisting of those SAB members identified by the SAB Chair as having the requisite combination of technical skills needed to provide the relatively quick, tightly focused feedback and advice requested by the Air Force senior leadership.

Study Requested by
SAB/AQ, AF/TE, AF/XOM

Committee Membership
Prof Alexander H. Levis, Study Chair
Mrs. Natalie W. Crawford, SAB Member
Dr. Charles L. Morefield, SAB Member
Dr. Duncan C. Miller, Ad Hoc Advisor
Dr. Cindy L. Williams, Ad Hoc Advisor

General Officer Participant
Brig Gen Frank B. Campbell, HQ USAF/XOM

Senior Civilian Participant
Dr. Marion L. Williams, HQ AFOTEC/CN

Action Office
AF/XOM

SAB Executive Officer
Maj Gaetano DeGioia, AF/SB

AF/XOM Liaison
Col George DeGovanni, USAF

AF/TE Liaison
Maj Bryan K. Ishihara

ANSER Analyst
Dr. Joseph D. Morgan III

APPENDIX B

MEMBERS AND AFFILIATIONS

MEMBERS AND AFFILIATIONS

SAB Members

Dr. Alexander H. Levis,
Chair, Systems Engineering Department
George Mason University

Mrs. Natalie W. Crawford
Director, Theater Forces Program
The Rand Corporation

Dr. Charles L. Morefield
Private Consultant

Ad Hoc Advisors

Dr. Duncan C. Miller
Senior Staff
MIT Lincoln Laboratory

Dr. Cindy L. Williams
Associate Technical Director
Continental C^3
The Mitre Corporation

APPENDIX C

MEETINGS

MEETINGS

11 November 1993, The Pentagon, Washington, DC

The chair held a preliminary review of JMASS with the JMASS SPO and contractors. Documents were provided by the SPO.

11 and 12 January 1994, ANSER, Arlington, VA

The Ad Hoc Committee met and received a series of briefings:

- *Modeling and Simulation Needs for Test and Evaluation*
  — Dr. Marion L. Williams, Chief Scientist and Technical Director, HQ AFOTEC/CN, Kirtland AFB, NM

- *JMASS Presentations*
  — Lt Col David B. Russell, ASC/RWWW, Wright-Patterson AFB, OH
  — Capt William M. Cashman, ASC/RWWW, Wright-Patterson AFB, OH
  — Capt Richard Painter, WL/AAWA-1, Wright-Patterson AFB, OH
  — Mr. Brian W. Beebe, SAIC, Dayton, OH

- *DIA Model Development*
  — Mr. G. Francis Kline, Missile and Space Intelligence Center, Redstone Arsenal, AL

- *JMASS User Experience*
  — Mr. Richard E. Sharp, NAIC/TAEM, Wright-Patterson AFB, OH

- *SMART and JMASS*
  — Mr. David H. Hall, SMART Joint Program Manager, NAWCWPNS, China Lake, CA

- *Modeling and Simulation*
  — Dr. Dale B. Henderson, Los Alamos National Laboratory, Los Alamos, NM

- *PRISM*
  — Capt. Paul A. Valdez, ESC/ENSF, Hanscom AFB, MA
  — Mr. Peter Maravelias, ESC/ENS, Hanscom AFB, MA

APPENDIX D

SAB BRIEFING ON AD HOC STUDY ON THE JOINT MODELING AND SIMULATION SYSTEM (JMASS)

AFSAB

AIR FORCE
SCIENTIFIC ADVISORY BOARD

AD HOC STUDY ON THE

JOINT MODELING AND SIMULATION SYSTEM

(JMASS)

JANUARY 1994

AFSAB

OUTLINE

- TASK DESCRIPTION
- JMASS
- FINDINGS – JMASS SPO
- FINDINGS – AIR FORCE
- RECOMMENDATIONS

AFSAB

TASK DESCRIPTION

THE STUDY WAS REQUESTED BY AF/TE AND AF/XOM

THE TASK DESCRIPTION IS:

- REVIEW JMASS FOR CONSISTENCY AND CONGRUENCE BETWEEN TECHNICAL FOCUS AND RESOURCE AVAILABILITY
- COMPARE REQUIREMENTS DRIVING THE JMASS PROGRAM AGAINST ACTUAL DIRECTION
- INVESTIGATE EXTENSIBILITY OF JMASS TO MEET USAF NEEDS IN MODELING, SIMULATION AND ANALYSIS.
- PREPARE A SUCCINT REPORT FOR PRESENTATION.

Ad Hoc Study on JMASS

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JMASS AD HOC PANEL

PANEL MEMBERS	ALEXANDER H. LEVIS, Chair NATALIE W. CRAWFORD DUNCAN C. MILLER CHARLES L. MOREFIELD CINDY WILLIAMS
SENIOR OFFICER PARTICIPANT	Brig Gen FRANK B. CAMPBELL, USAF
SENIOR CIVILIAN PARTICIPANT	MARION L. WILLIAMS
AF/XOM LIAISON	Col GEORGE DEGOVANNI, USAF
EXECUTIVE OFFICER	Maj GAETANO DE GIOIA, USAF JOSEPH D. MORGAN, III (ANSER)

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JMASS (RELEASE 2)

JMASS IS

- **A SIMULATION SUPPORT SYSTEM** THAT CONTAINS
  - A SIMULATION ENGINE
  - AN EVENT PROCESSOR/SCHEDULER
  - INTERMODULE COMMUNICATIONS VIA AN INTERCONNECTION BACKPLANE
- **A DEVELOPER'S TOOLKIT**
  - MODEL LEVEL
  - SIMULATION LEVEL
- **A SIMULATION CONFIGURATION TOOLKIT**
- **ANALYST/USER TOOLKIT**
  - POST-PROCESSOR
- **AN ARCHITECTURE**

Ad Hoc Study on JMASS

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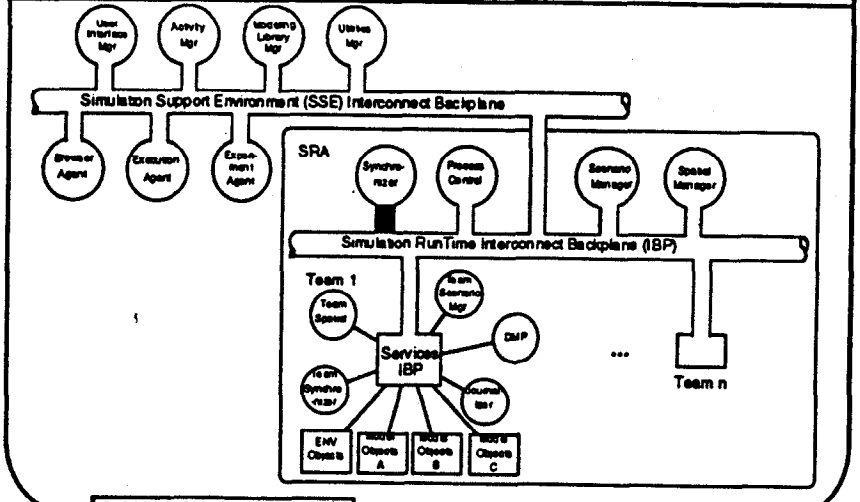
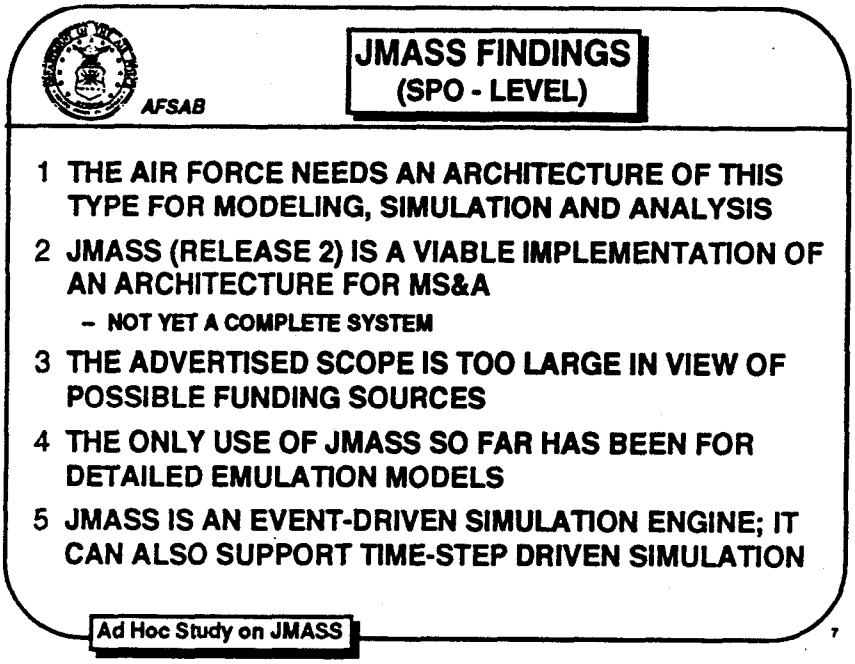
JMASS ARCHITECTURE
SIMULATION RUNTIME AGENT (SRA)



Ad Hoc Study on JMASS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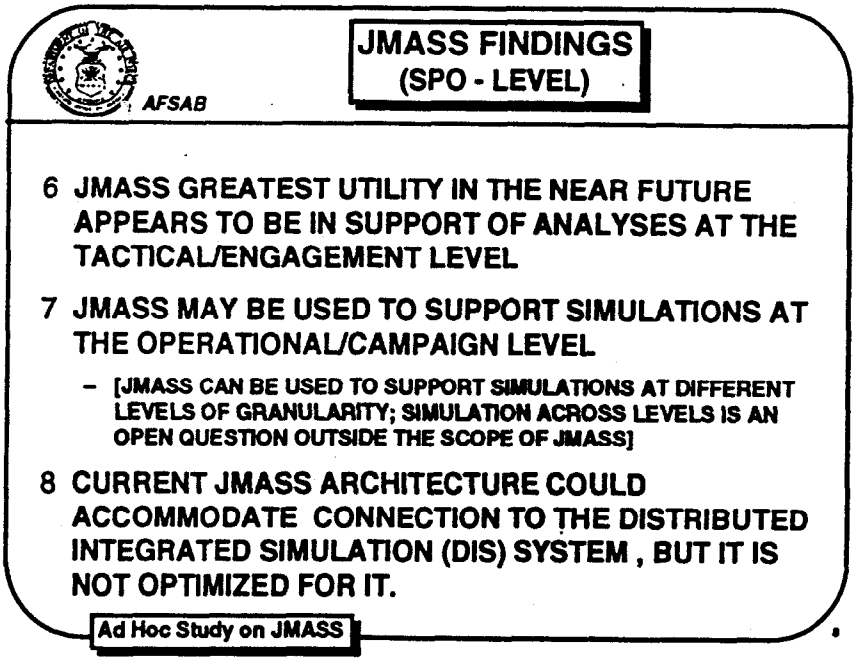
JMASS FINDINGS
(SPO - LEVEL)
1 THE AIR FORCE NEEDS AN ARCHITECTURE OF THIS TYPE FOR MODELING, SIMULATION AND ANALYSIS
2 JMASS (RELEASE 2) IS A VIABLE IMPLEMENTATION OF AN ARCHITECTURE FOR MS&A
- NOT YET A COMPLETE SYSTEM
3 THE ADVERTISED SCOPE IS TOO LARGE IN VIEW OF POSSIBLE FUNDING SOURCES
4 THE ONLY USE OF JMASS SO FAR HAS BEEN FOR DETAILED EMULATION MODELS
5 JMASS IS AN EVENT-DRIVEN SIMULATION ENGINE; IT CAN ALSO SUPPORT TIME-STEP DRIVEN SIMULATION
Ad Hoc Study on JMASS
7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JMASS FINDINGS
(SPO - LEVEL)
6 JMASS GREATEST UTILITY IN THE NEAR FUTURE APPEARS TO BE IN SUPPORT OF ANALYSES AT THE TACTICAL/ENGAGEMENT LEVEL
7 JMASS MAY BE USED TO SUPPORT SIMULATIONS AT THE OPERATIONAL/CAMPAIGN LEVEL
- [JMASS CAN BE USED TO SUPPORT SIMULATIONS AT DIFFERENT LEVELS OF GRANULARITY; SIMULATION ACROSS LEVELS IS AN OPEN QUESTION OUTSIDE THE SCOPE OF JMASS]
8 CURRENT JMASS ARCHITECTURE COULD ACCOMMODATE CONNECTION TO THE DISTRIBUTED INTEGRATED SIMULATION (DIS) SYSTEM , BUT IT IS NOT OPTIMIZED FOR IT.
Ad Hoc Study on JMASS
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JMASS FINDINGS (SPO - LEVEL)

9 INTEGRATED HUMAN-IN-THE-LOOP AND HARDWARE-IN-THE-LOOP CAPABILITY IN JMASS WOULD REQUIRE SUBSTANTIAL DEVELOPMENT

10 SUCH CAPABILITY IS NECESSARY FOR TRAINING APPLICATIONS (SUBSTANTIAL DEVELOPMENT WOULD BE REQUIRED)

11 ARCHITECTURE OF RELEASE 2 IS SOUND BUT PERFORMANCE IS UNTESTED

12 DECISIONS RELATED TO THE USE OF COTS ARE BASED ON LICENSING ISSUES, RATHER THAN FUNCTIONALITY AND LONG TERM SUPPORT

Ad Hoc Study on JMASS

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JMASS FINDINGS (AIR FORCE-LEVEL)

- NO STUDY/ANALYSIS EFFORT (APPLICATION) CURRENTLY IN PLACE THAT PLANS TO USE JMASS
- NO FIRM COMMITMENTS TO BUILD MODELS TO POPULATE JMASS LIBRARY
  - NAIC AND MSIC HAVE USED IT TO DEVELOP LOW-LEVEL ENGINEERING EMULATIONS; NOW BUILDING DYNAMIC MODELS
  - LEGACY MODELS COULD BE INCORPORATED, IF REQUIRED, BUT WITH SOME EFFORT
- NO OPERATIONAL REQUIREMENTS DOCUMENT TO GUIDE JMASS SPO
- DISTRIBUTION OF RELEASE 2 TO 13+ BETA SITES NOT SUFFICIENT STIMULUS TO GENERATE USER REQUIREMENTS

Ad Hoc Study on JMASS

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RECOMMENDATIONS

JMASS SHOULD BE CONTINUED ONLY IF:

- THE AIR FORCE ESTABLISHES A PLAN TO DEVELOP MODELS WITHIN THE JMASS ARCHITECTURE TO SUPPORT ONE OR MORE MAJOR APPLICATIONS (B1B FOR EXAMPLE)
- DOCUMENTED REQUIREMENTS TO SUPPORT THIS APPLICATION ARE TRANSMITTED TO JMASS SPO
- THE STAKEHOLDERS ARE APPROPRIATELY ORGANIZED TO CARRY OUT THE WORK
  - END-USERS
  - MODEL-DEVELOPERS
  - AFOTEC, DMSO, . . .
  - JMASS
- SUFFICIENT FUNDS ARE ALLOCATED TO ALL STAKE-HOLDERS IN THE APPLICATION

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RECOMMENDATIONS

- JMASS WILL BENEFIT FROM CLOSER CONNECTION TO THE USAF SOFTWARE DEVELOPMENT WORLD
- JMASS PERFORMANCE SHOULD BE TESTED BY EXERCISING SYSTEM IN A VARIETY OF RAPID DEMONSTRATIONS, e.g.:
  - CONNECTION TO DIS
  - INCLUSION OF LEGACY MODEL
  - HARDWARE-IN-THE-LOOP
- JMASS SHOULD BE FOCUSED FIRST ON THE TACTICAL/ENGAGEMENT LEVEL

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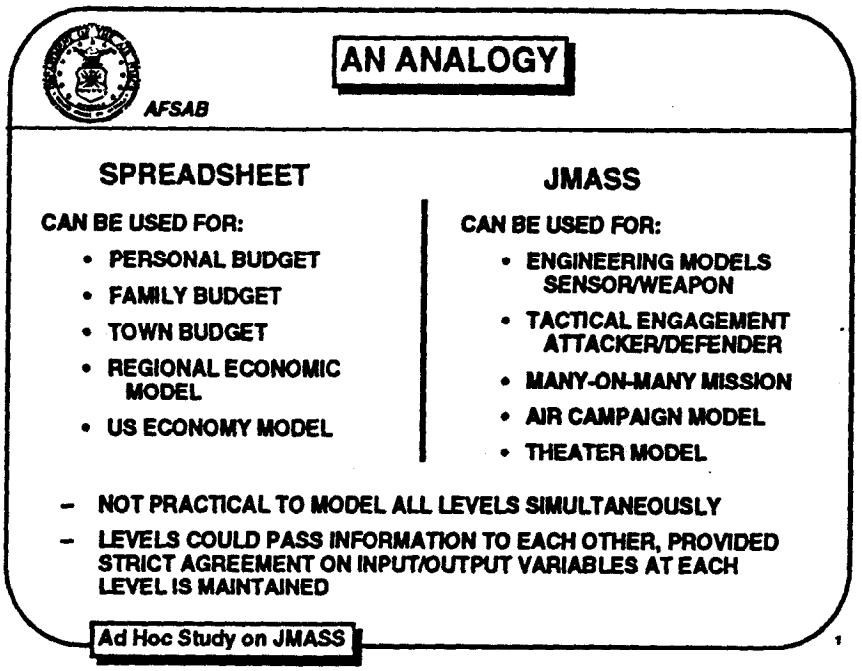
RECOMMENDATIONS

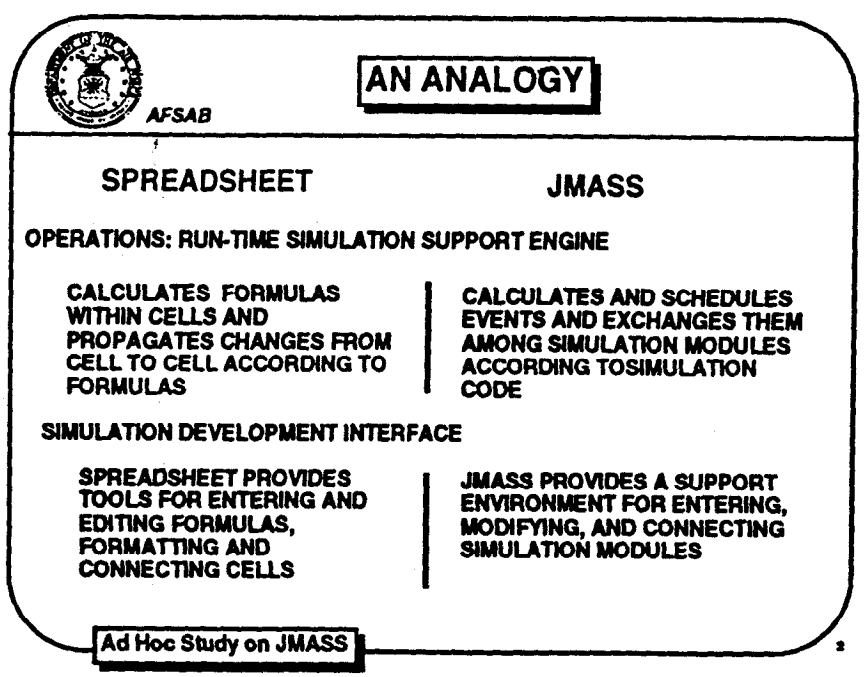
- USE OF COTS SHOULD BE CONTINUALLY RE-EVALUATED ESPECIALLY IN THE AREA OF DATA BASE MANAGEMENT SYSTEMS
  - INTERACTION WITH PRISM OFFICE, WHICH IS FOCUSING ON COTS USE, WOULD BE BENEFICIAL
- A SMALL ADVISORY GROUP SHOULD BE CONSTITUTED
  - TO REVIEW AND ADVISE ON:
    - SOFTWARE ENGINEERING TECHNOLOGY
    - MODELING AND SIMULATION TECHNOLOGY
    - USE OF COTS/GOTS
  - TO ASCERTAIN THAT FURTHER JMASS EFFORTS ARE DRIVEN BY MAJOR APPLICATIONS, AND
  - TO SERVE AS AN INTERFACE WITH THE POTENTIAL MODEL USERS ON REQUIREMENTS DEFINITION

Ad Hoc Study on JMASS

APPENDIX E

AN ANALOGY


AFSAB
AN ANALOGY
SPREADSHEET
CAN BE USED FOR:
• PERSONAL BUDGET
• FAMILY BUDGET
• TOWN BUDGET
• REGIONAL ECONOMIC MODEL
• US ECONOMY MODEL
JMASS
CAN BE USED FOR:
• ENGINEERING MODELS SENSOR/WEAPON
• TACTICAL ENGAGEMENT ATTACKER/DEFENDER
• MANY-ON-MANY MISSION
• AIR CAMPAIGN MODEL
• THEATER MODEL
– NOT PRACTICAL TO MODEL ALL LEVELS SIMULTANEOUSLY
– LEVELS COULD PASS INFORMATION TO EACH OTHER, PROVIDED STRICT AGREEMENT ON INPUT/OUTPUT VARIABLES AT EACH LEVEL IS MAINTAINED
Ad Hoc Study on JMASS
1


AFSAB
AN ANALOGY
SPREADSHEET
JMASS
OPERATIONS: RUN-TIME SIMULATION SUPPORT ENGINE
CALCULATES FORMULAS WITHIN CELLS AND PROPAGATES CHANGES FROM CELL TO CELL ACCORDING TO FORMULAS
CALCULATES AND SCHEDULES EVENTS AND EXCHANGES THEM AMONG SIMULATION MODULES ACCORDING TOSIMULATION CODE
SIMULATION DEVELOPMENT INTERFACE
SPREADSHEET PROVIDES TOOLS FOR ENTERING AND EDITING FORMULAS, FORMATTING AND CONNECTING CELLS
JMASS PROVIDES A SUPPORT ENVIRONMENT FOR ENTERING, MODIFYING, AND CONNECTING SIMULATION MODULES
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2

AFSAB

AN ANALOGY

- MODULE LINKING PROCEDURES

USERS CAN LINK SPREAD-SHEETS DEVELOPED BY OTHERS INTO WORKSETS AND ENTER NEW DATA INTO CELLS AND TABLES	USERS CAN SELECT SIMULATION MODULES FROM A LIBRARY, LINK THEM TOGETHER, AND ENTER INITIAL CONDITIONS AND PARAMETER TABLES

- OUTPUT ANALYSIS AND RESULTS PRESENTATION

SPREADSHEETS PROVIDE A VARIETY OF ANALYSIS AND PLOTTING FUNCTIONS	JMASS PROVIDES LIBRARIES OF ANALYSIS AND PLOTTING FUNCTIONS FOR SIMULATION RESULTS

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